

THE FERN GAZETTE

Edited by

J.M.Camus & J.A.Crabbe



THE
BRITISH
PTERIDOLOGICAL
SOCIETY

Volume 15 Part 6

1998

THE BRITISH PTERIDOLOGICAL SOCIETY

Patron: HRH The Prince of Wales

Officers and Committee from October 1997

President: **M.H. Rickard**

Vice-Presidents: **J.H. Bouckley, Dr N.J. Hards, Dr T.G. Walker, J.R. Woodhams**

Honorary General Secretary and Archivist: **A.R. Busby**
'Croziers', 16 Kirby Corner Road, Canley, Coventry CV4 8GD
Tel.: 01203 715690

Membership Secretary: **M.S. Porter**, 5 West Avenue, Wigton, Cumbria CA7 9LG
Tel.: 016973 43086

Treasurer: **A.M. Leonard**, 11 Victory Road, Portsmouth, Hants. PO1 3DR
E-mail: GBZURALE@IBMAIL.COM

Meetings Secretary: **P.J. Acock**, 13 Star Lane, St Mary Cray, Kent BR5 3LJ

Editors of the Fern Gazette: **Miss J.M. Camus & J.A. Crabbe**
Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD
E-mail: J.CAMUS@NHM.AC.UK

Editor of the Pteridologist: **Prof. B.A. Thomas**
Department of Geography, University of Wales Lampeter, Lampeter, Ceredigion SA38 7ED
Fax: 01570 424714, E-mail: B.THOMAS@LAMP.AC.UK

Editor of the Bulletin: **Miss A.M. Paul**
Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD
E-mail: AMP@NHM.AC.UK

Editor of BPS WWW Site: **A.C. Pigott**
Kersey's Farm, Mendlesham, Stowmarket, Suffolk IP14 5RB
E-mail: ANTHONY.PIGOTT@BTINTERNET.COM

Committee: **E.J. Baker, Miss J.M. Ide, A.C. Jermy, Miss H.S. McHaffie, Miss R.J. Murphy, Mrs M.E. Nimmo-Smith, M.S. Porter, R.N. Timm, Prof. A.C. Wardlaw**

Conservation Officer: **R.J. Cooke**, 15 Conduit Road, Stamford, Lincs. PE9 1QQ

Spore Exchange Organisers: **Mr & Mrs B. Wright**
130 Prince Rupert Drive, Tockwith, York YO5 8PU

Plant Exchange Organisers: **Mr & Mrs R.J. Smith**
184 Solihull Road, Shirley, Solihull, Warwicks. B90 3LG

Booksales Organiser: **S.J. Munyard**, 234 Harold Road, Hastings, East Sussex TN35 5NG

Trustees of Greenfield and Centenary Funds: **M.H. Rickard, A.R. Busby, A.M. Leonard**

The **BRITISH PTERIDOLOGICAL SOCIETY** was founded in 1891 and today continues as a focus for fern enthusiasts. It provides a wide range of information about ferns through the medium of its publications and other literature. It also organises formal talks, informal discussions, field meetings, garden visits, plant exchanges, a spore exchange scheme and fern book sales. The Society has a wide membership which includes gardeners, nurserymen and botanists, both amateur and professional. The Society's journals, the *Fern Gazette*, *Pteridologist* and *Bulletin*, are published annually. The *Fern Gazette* publishes matter chiefly of specialist interest on international pteridology, the *Pteridologist*, topics of more general appeal, and the *Bulletin*, Society business and meetings reports. **WWW site:** http://www.nhm.ac.uk/hosted_sites/bps/

Membership is open to all interested in ferns and fern-allies. **SUBSCRIPTION RATES** (due on 1st January each year) are Full Personal Members £15, Personal Members not receiving the *Fern Gazette* £12, Student Members £9, Subscribing Institutions £25. Family membership in any category is an additional £2. Applications for membership should be sent to the Membership Secretary (address above) from whom further details can be obtained. (Remittances made in currencies other than Sterling are £5 extra to cover bank conversion charges.) **Airmail** postage for all journals is an extra £4, or for those not receiving the *Fern Gazette* £2.50. **Standing Order** forms are available from the Membership Secretary.

Back numbers of the *Fern Gazette*, *Pteridologist* and *Bulletin* are available for purchase from P.J. Acock, 13 Star Lane, St Mary Cray, Kent BR5 3LJ, from whom further details can be obtained.

TRICHOMANES SPECIOSUM WILLD. (HYMENOPHYLLACEAE: PTERIDOPHYTA) IN SOUTHERN SPAIN

F.J. RUMSEY & J.C. VOGEL

Conservation Biology Laboratory, Department of Botany,
Natural History Museum, Cromwell Road, London, SW7 5BD, U.K.

Key words: Macaronesian enclave, refugium, Tertiary relict flora, conservation.

ABSTRACT

The history of the discovery, present distribution and status of *Trichomanes speciosum* in southern Spain is given. A new site in the Sierra de Montecoche, supporting the gametophyte generation only, is reported. The sporophyte generation has apparently declined in outlying areas; the extent to which this is a natural cyclical process in drier periods is uncertain. Habitat degradation through human activity has undoubtedly exacerbated climatic effects. The species array present supports the hypothesis that this area has acted as a European mainland refugium for Tertiary relicts otherwise largely restricted to the Atlantic Islands. Protection of the sites supporting Macaronesian floral elements is urgently required.

INTRODUCTION

Trichomanes speciosum Willd. (syn. *Vandenboschia speciosa* (Willd.) Kunkel) is the sole native European species of a widespread genus (Tutin *et al.*, 1993). A Macaronesian-European endemic, it has been considered one of the continent's most threatened pteridophytes. Excessive past collection for horticulture (Allen, 1969), and the herbarium, in combination with the restriction of small sporophyte populations to few, scattered and vulnerable sites has necessitated legal protection throughout the species range under the Bern Convention (Anon, 1979) and the Habitats Directive (Anon, 1992). *Trichomanes speciosum* has also been listed as globally rare in the IUCN Red List (Walter & Gillet, 1998).

Recent studies, summarised in Rumsey *et al.* (1998), have revealed that the gametophyte (sexual phase) of the life cycle, first described from cultivated material (Goebel, 1888), but not reported in the wild until over a century later (Rumsey *et al.*, 1990), is scattered across Britain and Ireland and parts of continental Europe. Similar 'independent' *Trichomanes* gametophyte populations have been reported in northern temperate areas of the U.S.A. (Farrar, 1967, 1985, 1992) but *T. speciosum* would appear unique in that both populations with gametophytes only and those with both gametophyte and sporophyte generations are widespread.

PAST RECORDS OF TRICHOMANES SPECIOSUM IN SOUTHERN SPAIN

Knowledge of the presence of Macaronesian floristic elements in the hills in the Algeciras area dates from the report of the discovery of *Culcita macrocarpa* C. Presl in the Miel Valley, a few kilometers W.S.W. of Algeciras (Allorge, 1934). However, both *C. macrocarpa* and the now lost *Dryopteris guanchica* Gibby & Jermy had been collected in this area by English botanists in the nineteenth century, who either failed to appreciate their significance or misidentified the material (Fraser-Jenkins, 1982). Curiously Allorge (1934) did not record *Trichomanes speciosum*, or *Diplazium caudatum* (Cav.) Jermy, both of which later authors report as growing close to the *Culcita* in this area. This omission led Nieschalk and Nieschalk (1965) to suspect that the *Culcita* site they subsequently discovered in the Miel Valley might not be the same as Allorge's, as they found *T. speciosum* to be a frequent associate and indeed to be scattered elsewhere by the streambed lower in the valley. Contrary to the statement in Salvo Tierra (1982), this was not the first discovery of *T. speciosum* in this region, that distinction falling to the distinguished tropical botanist and bryologist P.W. Richards (Richards, 1934). He had previously drawn attention to the Atlantic bryophyte interest of the

"waterfall valley" [= Miel Valley] which he first visited in the spring of 1931 (Richards, 1932). *Trichomanes* was discovered on a return visit in April 1934, growing "very sparingly on wet sandstone rocks in a small cave near a waterfall." He makes no mention of *Culcita* in his short account. It seems most unlikely that this area should have been visited independently by Richards and Allorge. The date of Allorge's visit is not given in his account (Allorge, 1934) but both he and Richards collected specimens of the Macaronesian moss *Lepidopilum virens* Card. (as *Plagiothecium argyrophyllum* Geh.) here in April of that year. These were the only known finds of this species on the European mainland until its recent rediscovery in this area by Hakelier (Sérgio *et al.*, 1995) and it seems probable, although not stated anywhere, that the two botanised together.

Richards' (1934) report and the oblique reference in Nieschalk and Nieschalk (1965) were overlooked by many, including Molesworth-Allen (1971). It was this paper, in which she reported *T. speciosum* from two unspecified localities, that brought to wider attention the presence not just of *Trichomanes* but also other pteridophytes with Macaronesian distributions, namely *Diplazium caudatum*, *Pteris serrulata* Forskål (= *P. incompleta* Cav.) and *Cyclosorus dentatus* (Forskål) Ching (= *Christella dentata* (Forskål) Brownsey & Jermy), in Cadiz province. Her careful researches in this region over the next few years revealed further sites for *T. speciosum* in the Algeciras, Los Barrios and Tarifa districts, i.e. on the Sierra de Luna, Sierra del Niño and Sierra de Ojén ranges (Molesworth-Allen, 1977). Her investigations then effectively defined the species' known range, with no subsequent published reports of additional localities, although the fern may additionally have occurred a little further west, on the Sierra de Saladavieja, the lower, westward continuation of the Ojén (Salvo, pers. comm.). It was searched for in this area during the 1995 Group of European Pteridologists (G.E.P.) excursion, but without success.

The distribution of *Trichomanes speciosum* was mapped by Salvo Tierra (1982) in his comprehensive study of the pteridophyte flora of Andalusia, in two hectads, 60TF00 and 70TF00. The total number of sites and their location are not given in the published accounts (Molesworth-Allen, 1971, 1977), which understandably sought to protect this species from over-collection, a fate which had befallen another rare disjunct pteridophyte discovered by the same author in this area, *Psilotum nudum* (L.) Beauv. (Molesworth-Allen, 1966). While she regarded *T. speciosum* as "locally abundant in a number of arroyos" (Molesworth-Allen, 1977), the three areas from which she then knew the plant supported only "40-50 plants or patches", of which few had been fertile.

AIMS

Two decades have passed since the above records from this phytogeographically important area, during which time patterns of land use have changed, levels of damaging human activity have increased, and higher local pollution loads and increasing aridity may have all affected these vulnerable, unique, refugial areas. The distinct species assemblage which characterises the Atlantic fringe of Europe and Macaronesia is particularly rich in cryptogamic species, many of which are rare and endangered. Since 1994 research has been carried out at the Natural History Museum into the distribution, ecology and historical biogeography of this community and its constituents. As part of this wider study these isolated sites in southern Spain were visited to determine the current extent of both generations of *Trichomanes speciosum*, a model organism which had been well studied elsewhere (see Rumsey *et al.*, 1998, in press).

MATERIALS AND METHODS

Where possible all previously reported sites of *T. speciosum* were visited. In addition, sites known to support, or to have supported, other disjunct Macaronesian elements were visited to ascertain whether the sporophyte, or the less conspicuous gametophyte generation was present.

We were fortunate to have access to the field notes made by Mrs Molesworth-Allen and her help and encouragement in the field.

RESULTS

Trichomanes speciosum was refound in all of the areas from which it had previously been reported. However, the species is now present only as the gametophyte generation in the Sierra del Niño, and on the eastern slope of the Sierra de Luna. One new site, well to the north of the previous discoveries, was detected while investigating the distribution of other Macaronesian taxa. Thus, we were fortunate to be guided to a recently discovered site for *Culcita macrocarpa*, an arroyo draining into the Embalse del Guadarranque on the N.E. side of the Sierra de Montecoche. The finder, Luis Federico Sanchez Tundidor, accompanied by Mrs. Molesworth Allen, a friend, and the authors were delighted to discover that the damp rock ledges by an impressive waterfall that supported the population of c. 15-20 *Culcita* plants also had extensive mats of *T. speciosum* gametophytes (Fig. 1). This extends the known range of both these species by c. 13km to the north-east (the nearest known sites for each are on the Sierra del Niño). In the area of the Sierra del Niño, where *T. speciosum* had previously been found, above La Granja, only a single site with a very small quantity of gametophyte was discovered in 1997. The habitat appeared generally unsuitable and had been further disturbed by a serious land-slip the previous winter. Only a single sporophyte colony had ever been known to Mrs Molesworth-Allen in this area (Molesworth-Allen, pers. comm.). No gametophytes were found in the extant site for *C. macrocarpa* elsewhere in the Sierra del Niño. Very small quantities of gametophyte were also found in a small streambed above the minor road between Tajo del Espino and Puerto de la Zarza, on the east side of the Sierra de Luna, high above the head of the Miel Valley at c. 550m altitude. A single large plant of *C. macrocarpa* grew by a small waterfall nearby.



Figure 1. Site of *Trichomanes speciosum* gametophyte population in the Sierra de Montecoche, May 1997. (Photo F.J. Rumsey)



Figure 2. *Trichomanes speciosum* flourishing by small streams on the Dehesa de Ojén, May 1997. Also present *Athyrium filix-femina* (L.) Roth and, middle right, *Pteris incompleta* Cav. (Photo J.C. Vogel)

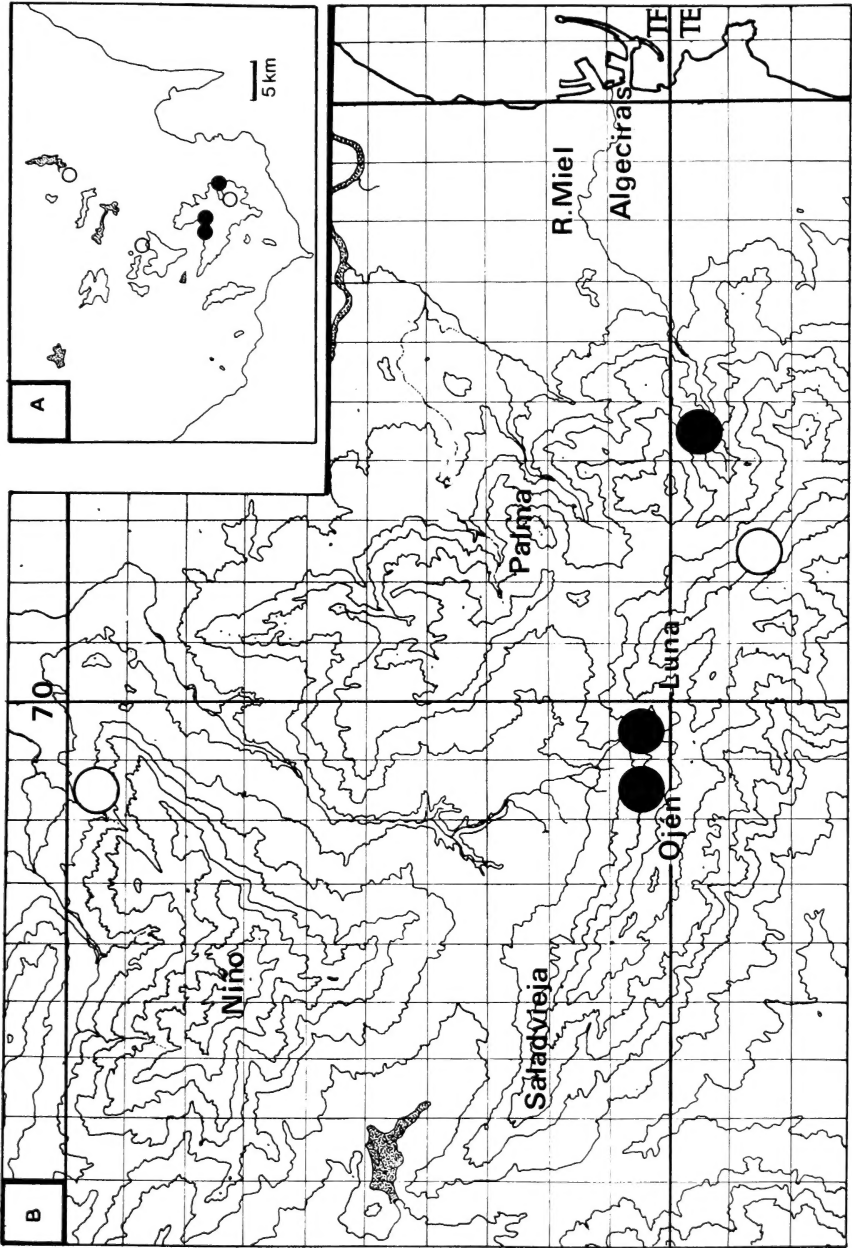


Figure 3a. Distribution of *Trichomanes speciosum* Willd. in southern Spain as revealed by field survey (1995-1997). Both generations recorded ●, Gametophyte generation only ○. The 500m contour line is included.

3b. The distribution within the Sierra de Ojén, Sierra de Luna and Sierra del Niño mapped on a 1km grid basis. Contour lines at 100m intervals.

In the Miel Valley only a single sporophytic plant of *Trichomanes speciosum* was seen in 1995 and re-found in 1997. This was growing adjacent to the only population of *Culcita macrocarpa* seen on these visits. No *Diplazium caudatum* or *Pteris incompleta* were seen in the valley in either year. The only area within which *T. speciosum* had maintained sporophytic numbers was the northern flank of the Sierra de Ojén, the Dehesa de Ojén up to the Collado Puerto del Viento on the S. E. flank of the Sierra de Luna. This population was apparently thriving; many fertile plants were seen and juvenile sporophytes were common on gametophyte mats (Fig. 2). The extent and condition of the sporophytes in this area would appear to depend on the condition of the mixed evergreen-deciduous woodland in which they occur, itself determined by activities such as cork-cutting and, more harmfully, clearance or burning. Indeed, Molesworth-Allen (pers. comm.) had noted that in a previous visit (post her optimistic 1977 account) few sporophytes could then be found in this area. *Diplazium caudatum*, *Pteris incompleta* and *Polystichum setiferum* (Forskål) Woynar were all seen in reasonable quantity and health, the last, in number and location almost exactly as reported by Molesworth-Allen (1977). Of concern was the apparent absence of *C. macrocarpa*, the loss of which could only realistically be explained by its selective removal. The terrain is however, difficult to search and this species and other interesting finds might still be made in the more remote areas.

The distribution of *Trichomanes speciosum* in southern Spain as revealed by our survey is given in Figure 3.

DISCUSSION

The detection of the gametophyte generation of *T. speciosum* was to be expected given the frequency of its occurrence in more northerly and continental areas of Europe (Vogel *et al.*, 1993; Rumsey *et al.*, 1998). What is, perhaps, surprising is that more sites were not located fringing those that currently maintain both generations. Evidence from elsewhere and the finds reported here from high on the Sierra de Luna and in the Sierra del Niño, demonstrate the ability of the gametophyte to persist in areas which once supported the sporophyte. The lack of additional gametophyte sites must reflect the general unsuitability of the habitat for both generations; harsh environmental and climatic changes occur over such short distances that little habitat exists that could be considered suitable for gametophytes outside of the very restricted areas suitable for sporophyte growth.

When compared with earlier accounts (e.g. Nieschalk & Nieschalk, 1965; Molesworth-Allen, 1971, 1977) the population present in the best known and most accessible site, the Miel Valley, has suffered a severe and perhaps catastrophic decline. *Trichomanes speciosum* is not the only taxon to have suffered in this way. *Diplazium caudatum*, first reported on the European mainland from this site in 1969 (Molesworth-Allen, 1971) and suggested to have suffered from collection (Molesworth-Allen, 1977), may now be absent from the valley. *Culcita macrocarpa* has vanished from the more accessible of its past sites lower in the valley, but persists higher up where most casual visitors do not reach. Increased rambling and other outdoor pursuits, opening up of the undergrowth, felling in the wider area, higher incidence of fires, when coupled with a run of drier than average years is steadily reducing the conservation interest of this area. Only the inaccessibility of the still comparatively unspoilt and now unique vegetation on the Dehesa de Ojén has acted to protect it. These very restricted woodland areas with their Tertiary relict Macaronesian cryptogamic flora, the sole Iberian sites for a range of disjunct flowering plants, e.g. *Arisarum proboscideum* (L.) Savi, are a national treasure and of international significance. Their active conservation must be addressed.

ACKNOWLEDGEMENTS

We would like to thank the NERC who funded this research under grant GR3/09451. We also must record our deep gratitude to Mrs Betty Molesworth-Allen for information, arranging access with landowners, spritely company in the field and her optimistic navigation on the

"road to Hell"! We also thank Fede Tundidor for sharing with us his exciting discovery of the new *Culcita* locality.

REFERENCES

- ALLEN, D.E. 1969. *The Victorian fern craze*. Hutchinson, London.
- ALLORGE, P. 1934. Le *Culcita macrocarpa* Presl [*Balantium Culcita* (L'Herit.) Kauffm.] dans les montagnes d' Algesiras. *Bull. Soc. Bot. France* **81**: 592-593.
- ANON. 1979. *The Convention on the Conservation of European Wildlife and Natural Habitats*. Council of Europe, Strasbourg.
- ANON. 1992. Council directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild faunas and floras. *Official journal of the European Communities* **206**: 7-49.
- FARRAR, D.R. 1967. Gametophytes of four tropical fern genera reproducing independently of their gametophytes in the southern Appalachians. *Science* **155**: 1266-1267.
- FARRAR, D.R. 1985. Independent fern gametophytes in the wild. *Proc. R. Soc. Edinb.* **86B**: 361-369.
- FARRAR, D.R. 1992. *Trichomanes intricatum*: the independent *Trichomanes* gametophyte in the Eastern United States. *Amer. Fern J.* **82**: 68-74.
- FRASER- JENKINS, C.R. 1982. *Dryopteris* in Spain, Portugal and Macaronesia. *Bol. Soc. Bot., Sér. 2*, **55**: 175-336.
- GOEBEL, K. 1888. Morphologische und biologische Studien: II. Zur Keimungsgeschichte einiger Farne. *Ann. Jard. Buitenz.* **7**: 74-119.
- MOLESWORTH-ALLEN, B. 1966. *Psilotum nudum* in Europe. *Brit. Fern Gaz.* **9**: 249-251.
- MOLESWORTH-ALLEN, B. 1971. Observations on Spanish ferns. *Brit. Fern Gaz.* **10**: 200-202.
- MOLESWORTH-ALLEN, B. 1977. Observations on some rare Spanish ferns in Cadiz province, Spain. *Fern Gaz.* **11**: 271-275.
- NIESCHALK, A. & NIESCHALK, C. 1965. Ein Stammfarn (*Culcita macrocarpa*) auf europäischem Boden. *Natur und Museum* **95**: 495-498.
- RICHARDS, P.W. 1932. Note on the bryophytes of the "Waterfall Valley" near Algeciras: an outpost of the Atlantic flora. *Rev. Bryol. et Lichén.* **5**: 1-9.
- RICHARDS, P.W. 1934. *Trichomanes radicans* Sw. in the south of Spain. *J. Bot. (London)* **72**: 351.
- RUMSEY, F.J., SHEFFIELD, E. & FARRAR, D.R. 1990. British filmy-fern gametophytes. *Pteridol.* **2**: 40-42.
- RUMSEY, F.J., JERMY, A.C. & SHEFFIELD, E. 1998. The independent gametophytic stage of *Trichomanes speciosum* Willd. (Hymenophyllaceae), the Killarney Fern and its distribution in the British Isles. *Watsonia* **22**: 1-19.
- RUMSEY, F.J., VOGEL, J.C., RUSSELL, S.J., BARRETT, J.A. & GIBBY, M. in press. Climate, colonisation and celibacy: population structure in Central European *Trichomanes speciosum* (Pteridophyta). *Bot. Acta*.
- SALVO TIERRA, A.E. 1982. *Flora pteridofítica de Andalucía*. Unpublished PhD. Thesis, Universidad de Málaga, Spain.
- SÉRGIO, C., BRUGUÉS, M. & CROS, R.M. 1995. Threatened bryophytes in the Iberian Peninsula - Some results and comments. *Crypt. Helv.* **18**: 51-56.
- TUTIN, T.G., BURGESS, N.A., CHATER, A.O., EDMONDSON, J.R., HEYWOOD, V.H., MOORE, D.M., VALENTINE, D.H., WALTERS, S.M. & WEBB, D.A. 1993. *Flora Europaea* Vol. 1, 2nd ed. Cambridge University Press, Cambridge.
- VOGEL, J.C., JESSEN, S., GIBBY, M., JERMY, A.C. & ELLIS, L. 1993. Gametophytes of *Trichomanes speciosum* (Hymenophyllaceae: Pteridophyta) in Central Europe. *Fern Gaz.* **14**: 227-232.
- WALTER, K.S. & GILLET, H.J. 1998. *IUCN Red List of threatened plants of the world*. New York Botanical Garden, New York.

BOOK REVIEW

THE FERNS OF BRITAIN AND IRELAND. C.N. Page. 1997 (2nd edition). Cambridge University Press, Cambridge. Hardback £95, ISBN 0 521 58380 2; paperback £40, ISBN 0 521 58658 5.

The British Isles are not only blessed with a rich fern flora, they are also blessed with a wealth of books about pteridophytes. One of the most outstanding and innovative contributions has been the first edition of *The ferns of Britain and Ireland* by Dr C.N. Page, published in 1982. This book has now appeared in its second edition, but at a considerably increased price. At such a price, Page has to stand the test against the standard in European fern Floras, the *Illustrierte Flora für Mitteleuropa*, in short 'Hegi', published in its third edition by Prof. K. Kramer in 1984.

Page starts his book with a general introduction to ferns/fern allies and the factors, geography, soils and climate, which influence the distribution and occurrence of pteridophytes in the British Isles. Fern taxa thereafter are organised in an alphabetical order, not reflecting the phylogenetic or systematic order. For each species at least three visual aids are provided: distribution maps (hand-drawn), a chart of the phenology and silhouettes/pictures. The text for each taxon covers at least four parts: identification, variation, possible confusion, technical confirmation and field notes. The distribution maps appear coarse and hand-drawn and are of a standard which, I fear, is no longer acceptable taking into account progress in modern computer technology. The parts on 'identification, variation, confusion with other taxa' and the illustrations of the ferns (both as silhouettes and photos) are still some of the best available. Here are the unquestionable strong parts of this book.

My appreciation of the 'field notes' provided for each taxon, is mixed. In a way, the field notes are one of the highlights of the book, but they also contain some of the weakest parts, especially when subjected to scientific scrutiny. On the one hand Chris Page lets the reader participate in his enormous knowledge and field experience about the ecology and biology of pteridophytes in the British Isles. I have read these chapters with great interest and I have gained from it. On the other hand, the author can fall, in parts, into what I would describe as 'unsubstantiated rumour'. While this has perhaps an entertainment value for the fortunate few (like the reviewer), who can devote their life to the scientific study of ferns, it might cause confusion and could lead to a misinformation of the general reader. We can read on page 380 of the perpetuation of the myth of inbreeding depression being responsible for the absence of *Trichomanes speciosum* sporophytes in the British Isles. Fortunately this problem is soon to be rectified by Rumsey *et al.* (1999) in a forthcoming paper in the *Biological Journal of the Linnean Society*. But there is worse to come on page 134: Page's considerations about the status of *Athyrium flexile* as an endemic Scottish taxon and as an "*incipient insular species in evolutionary terms*". Dr Chris Page has been in employment for many years at the Royal Botanic Gardens of Edinburgh, a well-respected Scientific Institute. To proclaim his 'gut feelings' on the status of *A. flexile* as a valued scientific opinion is irritating. It is well known that scientific questions in this day and age are addressed by a well designed experiment and its sometimes strenuous execution, and that is exactly what Heather McHaffie from Edinburgh has been doing for the last 3-4 years. Therefore, the statement of Page that *Athyrium flexile* is a Scottish endemic, whatever its genetic status, is not acceptable from a scientific point of view; an answer to this question depends on the outcome of the experiments. Taxonomy has always accommodated new scientific evidence, and will do so in the future. ...

Continued on page 214

POPULATION ANALYSIS OF THE TYPE LOCALITIES OF SOME
RECENTLY RECOGNISED TAXA OF BRITISH *PTERIDIUM*
(DENNSTAEDTIACEAE: PTERIDOPHYTA)

K.M. BRIDGES, C.J. ASHCROFT & E. SHEFFIELD
School of Biological Sciences, University of Manchester,
3.614 Stopford Building, Oxford Road, Manchester, M13 9PT, U.K.

Key words: bracken, clonal growth, isozyme analyses, *Pteridium*

ABSTRACT

Isozyme analyses show that the type localities for plants recently ascribed to *Pteridium pinetorum* subsp. *osmundaceum* and subsp. *pinetorum* contain several genetically distinct individuals. Two geographically separated samples of *P. aquilinum* subsp. *fulvum* share isozyme fingerprints which differ from any of the other plants analysed here, but which have been found elsewhere in Scotland within *Pteridium aquilinum* subsp. *aquilinum*.

Although our data show that there is more than one *Pteridium* genotype at two type localities, they do not negate the possibility that the differences in morphology of these plants from neighbouring *P. aquilinum* subsp. *aquilinum* are due to the influence of some environmental factor(s).

INTRODUCTION

Prior to 1989 it was commonly accepted that all bracken (*Pteridium*) in the British Isles belonged to one taxon - *P. aquilinum* (L.) Kuhn subsp. *aquilinum*. In 1989, and later in 1995, it was proposed (Page, 1989; Page & Mill, 1995 a & b) that this was not the case.

Page's 1989 paper introduced two taxa novel to the UK, and Page and Mill's publications in 1995 brought the total of *Pteridium* taxa reported in the UK to five, see Table 1 for summary.

Table 1: Changes in *Pteridium* taxonomy in the British Isles according to Page (1989) and Page and Mill (1995a & b).

Date	<i>Pteridium</i> taxa recognised
Up to 1989	<i>Pteridium aquilinum</i> (L.) Kuhn subsp. <i>aquilinum</i> was the only widely accepted taxon
1989	<i>P. aquilinum</i> subsp. <i>aquilinum</i> subsp. <i>atlanticum</i> C.N. Page (new subsp.) Page 1989. subsp. <i>latiusculum</i> C.N. Page (new to UK), Page 1989.
1995	<i>P. aquilinum</i> subsp. <i>aquilinum</i> subsp. <i>atlanticum</i> subsp. <i>fulvum</i> C.N. Page (new subsp.), Page and Mill 1995a <i>Pteridium pinetorum</i> C.N. Page & R.R. Mill (new species), Page and Mill 1995a subsp. <i>pinetorum</i> C.N. Page (new subsp.) subsp. <i>osmundaceum</i> (<i>sensu</i> Christ 1900) (Christ) C.N. Page (new subsp.)

These recently proposed taxa were defined solely on the basis of gross morphological and phenological characters in field specimens. The areas of type localities described as colonised by these taxa are small: the largest single patch encountered in this study (*P. pinetorum* C.N. Page & R.R. Mill subsp. *pinetorum*) extends for only 150m in maximum dimension, see Figure 1. Individuals of *Pteridium* are, however, well known to be capable of covering large areas by means of vegetative spread. Sheffield *et al.* (1989), for example, detected single genotypes

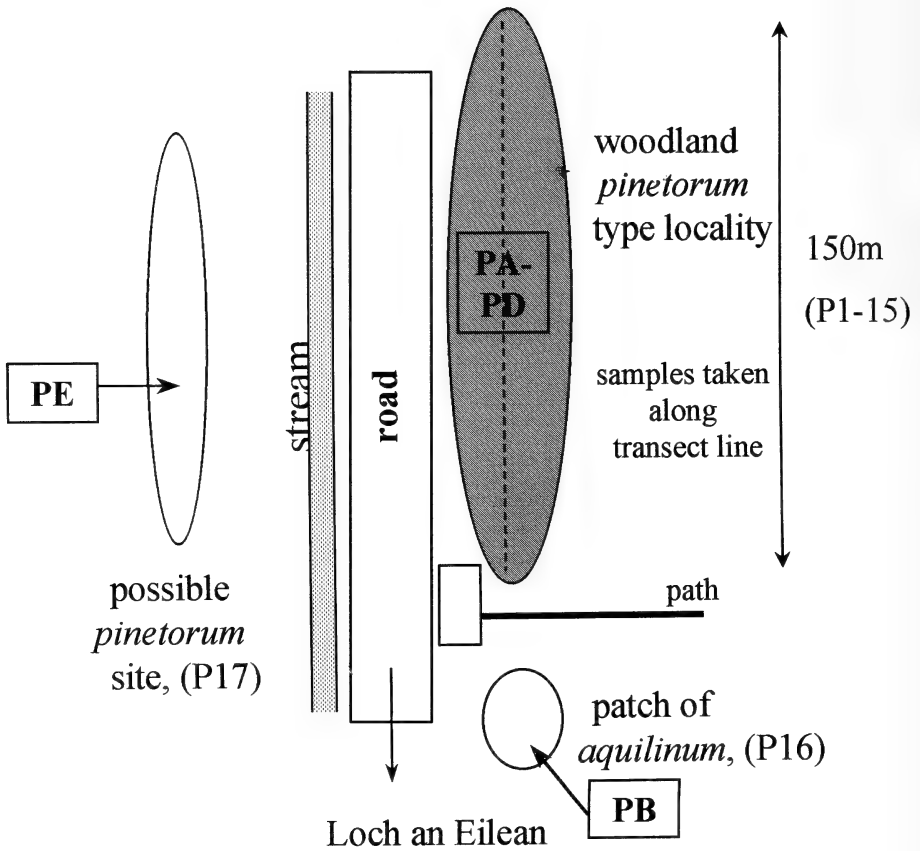


Figure 1: Schematic diagram of *P. pinetorum* subsp. *pinetorum* type locality, GRNH 896092, Inverness-shire, Scotland.

The shaded patch is at the cited grid reference for the type locality; the fronds in the patch on the left of the figure had a morphology similar to that of those at the published type locality. PA-PE are the different isozyme genotypes identified at the site. P16 is a patch of *Pteridium aquilinum* subsp. *aquilinum*.

extending for at least 390m in the UK, and Parks & Werth (1993) mapped individual North American genotypes up to 1015m in extent. This raises the possibility that the localities described for the new taxa contain only single genotypes and/or individuals (see also Rumsey, 1998) rather than populations (colonies) of individuals.

The aim of this study was therefore to sample within the type areas cited as containing these novel taxa of *Pteridium* in order to determine whether such localities comprise one or many genetically distinct individuals, the morphology of which is consistent with published descriptions. The prime focus was on localities occupied by the new species (*P. pinetorum*) and the method used to detect individuals was the allozyme multi-locus genotyping technique established by Sheffield *et al.* (1989). This technique allows an unequivocal statement of whether two or more plant samples are genetically different, but it cannot provide an unequivocal demonstration of genetic identity.

MATERIALS AND METHODS

All of the study sites listed herein have been pinpointed by Dr C.N. Page whilst in the field with one of the authors. If collections were not made in the company of Dr Page, the same site was revisited after precise notation of the exact location. At the type locality for *P. pinetorum* subsp. *pinetorum* (grid ref. NH 869092) there is a continuous patch of *Pteridium*; fifteen samples (one pinna, basal or near basal) were taken (11.8.96) at approximately 5-10m intervals along a transect (samples numbered P1-15). A sample was also taken from *Pteridium* adjacent to the type locality which did not match the published description of *P. pinetorum* subsp. *pinetorum* and was taken to be *P. aquilinum* subsp. *aquilinum* (sample P16) and from across a nearby stream which appeared close to the published description of *P. pinetorum* subsp. *pinetorum* (sample P17), see Figure 1.

At the *P. pinetorum* subsp. *osmundaceum* (Christ) C.N. Page type locality (grid ref. NN 778578) four discrete patches of *Pteridium* were present; all were consistent with the published description of *P. pinetorum* subsp. *osmundaceum*. Samples of basal/near basal pinnae were taken at each patch (samples Os1-28), see Figure 2. At Patch 1, samples were taken across a transect and a sample from every 4m was used (Os1-7); at Patch 2, samples were taken along a transect through the patch and samples from every 4m were used (Os8-12); Patch 3 was very narrow, so random samples were taken throughout, (Os13-22) and at Patch 4, samples were taken on a transect and samples from every 8-10m were used (Os23-28).

A collection (Os29) was also made of *Pteridium* near the *P. pinetorum* subsp. *osmundaceum* type locality, but in a different vegetation type (woodland) and also from the opposite side of the road, but not within the woodland, see Figure 2. The sample from the opposite side of the road resembled the *Pteridium* plants in the *P. pinetorum* subsp. *osmundaceum* type locality.

Not all collected material was analysed isozymically. Both ends of the patches, and samples along the transect (where applicable) were included in the current analyses, the remainder is in storage at -80°C pending further biochemical and molecular analysis.

For *P. aquilinum* subsp. *fulvum* C.N. Page, one collection was made, (grid ref. NN 887603). This site is on a steep slope near Loch Faskally, Perthshire and is one continuous patch. The fronds in this patch are clearly distinct in terms of their morphology from the surrounding *Pteridium* fronds, which were presumed to be *P. aquilinum* subsp. *aquilinum*. Material was collected from an individual frond (matching the *P. aquilinum* subsp. *fulvum* description) at this locality. Another (single) collection was made of *Pteridium* on the shores of Loch Rannoch (grid ref. NN 589586). Plants from both sites were identified by Dr C.N. Page as *P. aquilinum* subsp. *fulvum*. See Figure 3.

All frond samples were sealed in ziplock bags and stored at 4°C overnight before being sent to Manchester where portions were put into storage at -80°C.

P. aquilinum (L.) Kuhn subsp. *atlanticum* C.N. Page has been the subject of previous investigations following Page's 1989 publication (see Rumsey *et al.*, 1991; Wolf *et al.*, 1994),

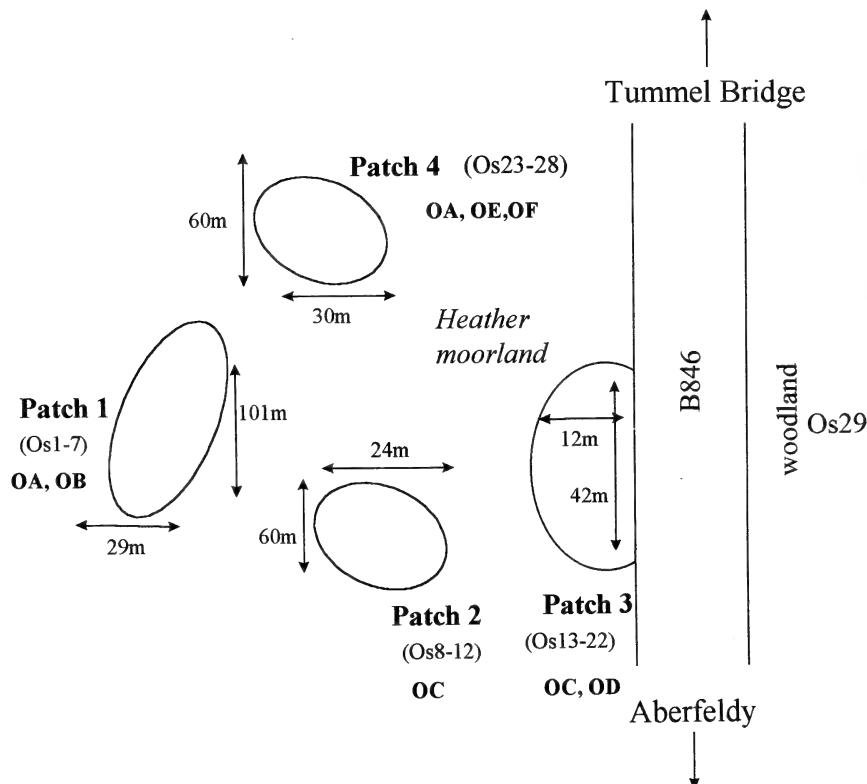


Figure 2: *P. pinetorum* subsp. *osmundaceum* type locality, GR 778578, Perthshire, Scotland.

OA-OF represent the different isozyme genotypes identified, and the measurements are the greatest extent in the indicated orientation. All four patches are part of the type locality.

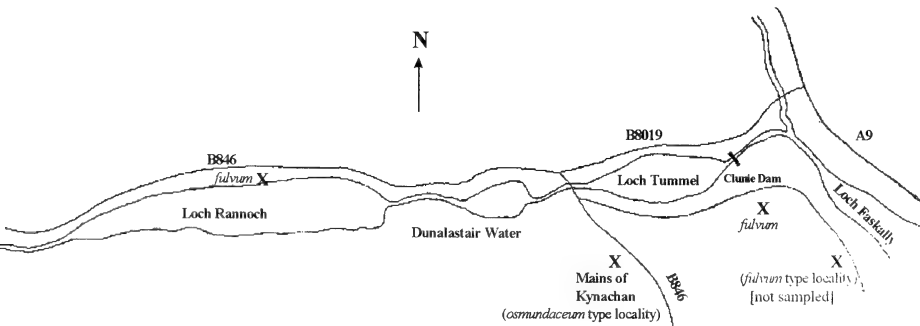


Figure 3: The location of sample sites for *P. aquilinum* subsp. *fulvum* and *P. pinetorum* subsp. *osmundaceum* included in this study.

and is the subject of other publications (Ashcroft & Sheffield in press) so will not be considered further here.

Isozyme analyses were carried out as per Soltis *et al.* (1983) with only minor modifications. All samples were stained for: aconitase (ACON) EC 4.2.1.3; aldolase (ALD) EC 4.1.2.13; aspartate aminotransferase (AAT) EC 2.6.1.1; glucose-6-phosphate dehydrogenase (G6PDH) EC 1.1.1.49; glyceraldehyde-3-phosphate dehydrogenase (G3PDH) EC 1.2.1.12; hexokinase (HK) EC 2.7.1.1; isocitrate dehydrogenase (IDH) EC 1.1.1.42; leucine aminopeptidase (LAP) EC 3.4.11; malate dehydrogenase (MDH) EC 1.1.1.37; malic enzyme (ME) EC 1.1.1.40; phosphoglucisomerase (PGI) EC 5.3.1.9; phosphoglucomutase (PGM) EC 2.7.5.1; 6-phosphogluconate dehydrogenase (6PGD) EC 1.1.1.44; shikimate dehydrogenase (SKDH) EC 1.1.1.25; triosephosphate isomerase (TPI) EC 5.3.11.

All gels were run with marker wicks of S48 (British *P. aquilinum* subsp. *aquilinum*). This *Pteridium* plant grows at the University of Manchester's Experimental Grounds in Fallowfield, Manchester.

Herbarium specimens of material used in this study have been deposited at the Manchester Museum Herbarium (MANCH).

RESULTS

No variation was detected for: AAT, ACON, ALD, F16D, G3PDH, G6PDH, HK, LAP, MDH-2, ME, PGI-1, PGM, 6PGD, TPI-1 in any of the samples analysed in this study. Variability was detected for IDH, MDH-1, MDH-3, PGI-2, SKDH, TPI-2.

Five isozyme genotypes were found at the *P. pinetorum* subsp. *pinetorum* site: (PA-E), see Tables 2 and 3, Figure 1. Five were for samples taken as *P. pinetorum* subsp. *pinetorum* (P1-15, 17); the frond sampled as being *P. aquilinum* subsp. *aquilinum* (P16) matches the isozyme genotype of P14 and P15.

Table 2: Genotypes found at the *P. pinetorum* subsp. *pinetorum* site

Sample number	Genotype
P1-7	PA
P8	PB (=OsA)
P9	PC
P10-11	PD (=OsD)
P12-16	PB (=OsA)
P17	PE

At the *P. pinetorum* subsp. *pinetorum* site P17 (the sample taken from across the stream, morphologically similar to *P. pinetorum* subsp. *pinetorum*) does not have the same genotype as any of the other samples, but P16 (sample from frond of standard *P. aquilinum* subsp. *aquilinum* appearance) shares the same isozyme profile as P12-15. Four different genotypes were found in the continuous patch of bracken at the *P. pinetorum* subsp. *pinetorum* type locality (samples P1-15).

Four isozyme genotypes were found at the *P. pinetorum* subsp. *osmundaceum* site: (OsA-D), see Tables 4 and 5 (Figure 2). Three were for fronds sampled in patches 1-4 (Os1-28) and one was for the sample taken from across the road (Os29).

The different *P. pinetorum* subsp. *osmundaceum* genotypes do not directly correspond to the four patches sampled. That is, there is some overlap of genotypes between patches. (See Figure 2). Samples Os24 and Os26 (within Patch 4) have the same genotype as samples Os1-6 (within Patch 1). Patch 1 has two genotypes; Patch 2 has one; Patch 3 has one, and Patch 4 has three genotype. Os29 is the sample from across the road, this sample has the same genotype as Os14-22 (Patch 3).

The two *P. aquilinum* subsp. *fulvum* samples (from near Loch Faskally and Loch Rannoch) were the same as each other and different from every other sample analysed here.

Table 3: Zymogram of *P. pinetorum* subsp. *pinetorum* samples, for variable isozymes only. Asterisks denote heterozygous individuals.

Sample	IDH	MDH	PGI-2	SKDH
P1*				
P2*				
P3*				
P4*				
P5*				
P6*				
P7*				
P8				
P9				
P10*				
P11*				
P12				
P13				
P14				
P15				
P16				
P17*				

Table 4: Genotypes found at the *P. pinetorum* subsp. *osmundaceum* site

Sample number	Patch number	Genotype
Os1-6	1	OsA (=PB)
Os7	1	OsB
Os8-12	2,3	OsC
Os13-22	3	OsD (=PD)
Os23	4	OsE
Os24-28	4	OsA
Os29	-	OsD (=PD)

Comparison of isozyme profiles between type sites.

Each type locality contained some genotypes identical for all isozymes tested to genotypes found elsewhere. Genotype OsA (*P. pinetorum* subsp. *osmundaceum* samples Os1-6 and Os 24-28) is the same as PB (*P. pinetorum* subsp. *pinetorum* samples P8 and P14-16). OsD (*P. pinetorum* subsp. *osmundaceum* samples Os13-22 and Os29) has the same isozyme genotype as PD (*P. pinetorum* subsp. *pinetorum* samples P 10-11). See Tables 2 & 3. The isozyme profile of plants referred to as *P. aquilinum* subsp. *fulvum* is identical to that of a plant sampled elsewhere in Scotland (GR 972511), not the location of a *Pteridium* type locality, analysed in a parallel study (Ashcroft, unpublished data).

DISCUSSION

Clonal pteridophytes present special problems for population analysis because individuals (genets) generate many morphological units (ramets). The identification of *Pteridium* genets within populations relied until recently upon morphological differences between individuals (e.g. Webster & Steeves, 1958; Oinonen, 1967). Such identification methods resulted in

Table 5: Zymogram of *P. pinetorum* subsp. *osmundaceum* samples, for variable isozymes only.

Asterisks indicate heterozygous individuals.

Sample	IDH	MDH	PGI-2	SKDH
Os1				
Os2				
Os3				
Os4				
Os5				
Os6				
Os7*				
Os8*				
Os9*				
Os10*				
Os11*				
Os12*				
Os 13*				
Os 14*				
Os 15*				
Os 16*				
Os 17*				
Os 18*				
Os 19*				
Os 20*				
Os 21*				
Os 22*				
Os 23*				
Os 24				
Os 25				
Os 26				
Os 27				
Os 28				
Os 29*				

underestimates of clonal size (Parks & Werth, 1993), and have been superseded by methods including multilocus allozyme genotyping (Sheffield *et al.*, 1989; Parks & Werth, 1993). The latter method reveals differences in the structure of only a limited number of proteins and cannot necessarily detect every genet, but genotypes that are revealed as distinct by the method do most certainly represent individuals that are genetically different from each other. It is particularly important to employ such methods where forms of a pteridophyte are reported to be correlated with edaphic parameters, as reported for the new *Pteridium* taxa (Page, 1997). The influence of a particular set of conditions, for example, soil, on a single genotype could generate atypical morphology of an otherwise standard form.

Pteridium has a 'guerrilla-type' clone-forming growth strategy, which results in intergrowth amongst genets. Patches cannot be assumed to consist of single genets, nor are boundaries between genets sharp (Parks & Werth, 1993). As forms of *Pteridium* are thought to be associated with particular sets of environmental parameters, it is crucial to determine whether such forms represent ramets of neighbouring genets of the common taxon (*P. aquilinum* subsp. *aquilinum*) which appear different only because of environmental pressures, or distinct genets.

The data presented herein do not support the hypothesis that the new taxa of bracken are based upon environmentally-modified extensions of neighbouring individuals fitting the descriptions of the common taxon of the genus. Each area occupied by plants ascribed to new taxa was found to contain one or more individuals genetically distinct from the surrounding bracken. This study has used more enzyme loci than many studies, and it is highly unlikely that the genotypes found with one or more heterozygous loci (the majority of the plants sampled) would be repeated, as bracken is known to be an outcrossing species (Sheffield, Wolf & Haufler 1989; Wolf *et al.*, 1988). Thus, their distinctive morphology cannot merely reflect perturbations of the morphology of clones surrounding these type areas which have grown into the habitats in question. These plants might of course, share an environmentally-induced phenotype. The areas identified as typifying the new taxa of the species *P. pinetorum* investigated in the present study do contain more than one individual matching the published description of the taxa. This means that the correct description of the *P. pinetorum*-inhabited areas described herein, and in Page 1997, is indeed "colonies" of individuals, i.e. populations, and not large single clones.

Spatial analysis of bracken genets based on reliable data is still in its infancy, and few studies have been published, but the current study is in broad agreement with others in finding that *Pteridium* populations comprise both small and large individuals. Growth rates for the species are similarly under-researched, but range from 25cm to over 100 cm per year for the *P. aquilinum* subsp. *aquilinum* taxon in one report (Sheffield *et al.*, 1989). Given the northerly locations of the site localities and a growth rate which is likely to be lower than that of the weedy form, it does seem reasonable to conclude that some of the individuals detected herein represent clones of considerable antiquity. Estimates of age of clones have been based on very different models of plant growth (see Sheffield *et al.*, 1993 for full account) but however conservative the estimate, it seems possible that the individuals detected in this study have survived for a substantial time in the face of competition from neighbouring *P. aquilinum* subsp. *aquilinum* individuals (the most aggressive of the *Pteridium* taxa; Page, 1997). It could also of course indicate that the *P. aquilinum* subsp. *aquilinum* taxon has only recently ventured into the neighbourhood. Only time, and further sampling in decades to come, would determine the correct interpretation of the current situation at these sites.

Finally, it should be noted that although the type areas of the new *P. pinetorum* taxa comprise populations and not merely single individuals, the isozyme profiles detected were not unique for each taxon. In each population there were individuals with isozyme profiles identical to individuals in populations ascribed to a different taxon. For *P. pinetorum* subsp. *fulvum*, no other individuals were detected with the same profile as the profiles recorded during the present study, but a parallel study has located individuals with this genotype that matched the description of *P. aquilinum* subsp. *aquilinum*. This does not necessarily question the validity of taxonomic recognition for these taxa, as there are organisms for which isozymes do not reflect taxonomic distinctions, but taxonomic considerations were not the focus of the current study and are the subject of ongoing research which includes common-garden cultivation of specimens collected at the study sites listed here.

ACKNOWLEDGEMENTS

The authors would like to thank Dr J. Bridges, Dr R.S. Callow, C. Ellis, Dr C.N. Page, S. Ross and J. Usherwood for help collecting material, and S. Challinor for technical assistance. Funding was provided by a BBSRC studentship to KMB and a NERC studentship to CJA.

REFERENCES

- ASHCROFT, C.J. & SHEFFIELD, E. In press. Rejection of *Pteridium aquilinum* subspecies *atlanticum* (C.N. Page). *Bot. J. Linn.Soc.*
- OINONEN, E. 1967. Sporal regeneration of Bracken (*Pteridium aquilinum* (L.) Kuhn) in Finland in the light of the dimensions and the age of its clones. *Acta Forrest. Fenn.* **83**: 1-96.
- PAGE, C.N. 1989. Three sub-species of Bracken, *Pteridium aquilinum* (L.) Kuhn, in Britain. *Watsonia* **17**: 429-434.
- PAGE, C.N. 1997. *The ferns of Britain and Ireland*. 2nd ed. Cambridge University Press, Cambridge.
- PAGE, C.N. & MILL, R. 1995a. Scottish Bracken (*Pteridium*): new taxa and a new combination. *Bot. J. Scot.* **47**: 139-140.
- PAGE, C.N. & MILL, R. 1995b. The taxa of Scottish Bracken in a European perspective. *Bot. J. Scot.* **47**: 229-247.
- PARKS, J. & WERTH, C. 1993. A study of spatial features of clones in a population of bracken fern, *Pteridium aquilinum* (Dennstaedtiaceae). *Amer. J. Bot.* **80**: 537-544.
- RUMSEY, F.J. 1998. Review of Page, C.N. *Ferns of Britain and Ireland* 2nd ed., Cambridge University Press. *Ann. Bot.(Oxford)* **81**: 297-301.
- RUMSEY, F.J., SHEFFIELD, E. & HAUFLER, C.H. 1991. A re-assessment of *Pteridium aquilinum* (L.) Kuhn in Britain. *Watsonia* **18**: 297-301.
- SHEFFIELD, E., WOLF, P.G. & HAUFLER, C.H. 1989. How big is a bracken plant? *Weed Res.* **29**: 455-460.
- SHEFFIELD, E., WOLF, P.G., RUMSEY, F.J., ROBSON, D., RANKER, T.A. & CHALLINOR, S.M. 1993. Spatial distribution and reproductive behaviour of a triploid bracken (*Pteridium aquilinum*) in Britain. *Ann. Bot.(Oxford)* **72**: 231-237.
- SOLTIS, D., HAUFLER, C.H., DARROW, D. & GASTONY, G. 1983. Starch gel electrophoresis of ferns: a compilation of grinding buffers, gel and electrode buffers, and staining schedules. *Amer. Fern J.* **73**: 9-27.
- WEBSTER, B., & STEEVES, T.A. 1958. Morphogenesis in *Pteridium aquilinum* (L.) Kuhn - general morphology and growth habit. *Phytomorphology* **8**: 30-41.
- WOLF, P.G., HAUFLER, C.H. & SHEFFIELD, E. 1988. Genetic variation and the mating system of the clonal weed *Pteridium aquilinum* (L.) Kuhn. *Evolution* **42**: 1350-1355.
- WOLF, P.G., SHEFFIELD, E., THOMSON, J.A. & SINCLAIR, R.B. 1994. Bracken taxa in Britain: a molecular analysis. In: Smith, R.T. & Taylor, J.A., (eds). *Bracken: an environmental issue*, pp 16-20. International Bracken Group, Aberystwyth.

BOOK REVIEWS

AUTHORS OF SCIENTIFIC NAMES IN PTERIDOPHYTA R. E. G. Pichi Sermolli. 1996. xxx + 78 pp. Royal Botanic Gardens, Kew. Price £12. ISBN 0 947643 90 7. Softback.

Every pteridophyte taxonomist should have their own copy of this book! For starters it is more manageable than that fine source of author abbreviations *Authors of Plant Names* by Brummitt and Powell (1992), to which Professor Pichi Sermolli contributed the main list of pteridophyte authors, and for seconds it contains an additional 401 names. It consists of a revised and updated list of pteridophyte authors and their abbreviations in the standard forms recommended by *Authors of Plant Names*, and an appendix of author abbreviations adopted in recent publications which differ from those used in APN and in this book together with their standard form equivalent. Needless to say it has been compiled with the accuracy and painstaking attention to detail we have come to expect from Professor Pichi Sermolli. The introduction is a fascinating read in its own right. In the section dealing with the citation and spelling of authors' names I particularly enjoyed the long discussion on Chinese names and the Wade-Giles and Pin-yin conventions for their romanisation. This slender volume is an absolutely indispensable tool for the pteridologist monographer and Flora writer.

B.S.Parris

THE FERNS OF BRITAIN AND IRELAND C.N. Page. Continued from page 204.

... If the general reader wants to learn about pteridophytes in the British Isles, Page's 'field notes' provides a lot of information, but how does one judge what to take as an authoritative statement, and what with a pinch of salt. A good solution to this problem would be to test his observations. One can only encourage the many fern enthusiasts in Britain and Ireland to take the 'field notes' as an inspiration to go out for one's self and to test Page's hypotheses by observing and experimenting. It might help to raise awareness out in the field and foster your scientific urges to prove Page right or wrong, but please do not forget to communicate your findings to the wider pteridological community by publishing in the *Fern Gazette* and other journals. It might help Chris Page with his third edition.

This book is a good and valuable read and it is the most comprehensive book on British and Irish ferns. As these Isles harbour a wealth of species the book is of great interest to fern enthusiasts from abroad. If you do not have the first edition, this book is a must. However, concerning biosystematics, progress in pteridology, and even additions to the British fern flora, the book rather reflects the state of knowledge of perhaps 1990, but certainly not that of 1997, the year it was published. The hardbound copy is £95, and this is a lot of money for a book on ferns (paperback £40). Despite all the good qualities this book certainly has, its second edition strikes me as a missed opportunity. The first edition was an outstanding piece of work but suffered from the poor reproduction of the fern specimen pictures, and this certainly has been rectified in the second edition. However, there were other areas where improvements would have to be made in order to stay ahead. The claim that the book has been fully updated is not supported by the contents. Sorry Chris, if I want to hold THE authoritative book of ferns in Europe in my hands, I will grab the Hegi.

J.C.Vogel

THE ADDITION OF *ACROSORUS STREPTOPHYLLUS* (BAKER) COPEL. (GRAMMITIDACEAE: PTERIDOPHYTA) TO THE FLORA OF THAILAND

B.S. PARRIS

Fern Research Foundation, 21 James Kemp Place,
Kerikeri, Bay of Islands, New Zealand

Key words: *Acrosorus streptophyllus*, Grammitidaceae, Thailand.

ABSTRACT

Acrosorus streptophyllus (Grammitidaceae: Pteridophyta) is reported for the first time from Thailand.

INTRODUCTION

Tagawa & Iwatsuki (1989) report only one species of the fern genus *Acrosorus* (Grammitidaceae) for Thailand. They record *A. triangularis* (Scort. ex Bedd.) Copel. for three regions, Surat Thani (Khao Nong), Nakhon Si Thammarat (Khao Luang) and Yala (Gunong Ina), in Peninsular Thailand. The correct name for this species is *A. friderici-et-pauli* (H. Christ) Copel., syn. *A. triangularis* Copel., a name based on *Polypodium triangulare* Scort. ex Bedd. (1887) non J.F. Gmel. (1791) nec Dulac (1867). Tagawa & Iwatsuki (1989) mention that another species, *A. streptophyllus* (Baker) Copel., is common in Malaya and Borneo and distinguish it from *A. friderici-et-pauli* by size of fronds, texture and soral construction without including it in the Flora.

Material of *Acrosorus* from Peninsular Thailand held in the herbaria of the Botany School, University of Cambridge (CGE) and the Royal Botanic Gardens, Kew (K) has been examined and found to contain both *A. friderici-et-pauli* and *A. streptophyllus*.

MATERIALS

Acrosorus streptophyllus specimens examined: Thailand: Peninsular; Yala (Gunung Ina) [Malay Peninsula, Perak, Gunung Inas], epiphytic on jungle trees, 3900 ft, 6 Dec. 1899, R.H. Yapp 405 (CGE p.p., K) and 405 bis (CGE). Yapp 405 at CGE is a mixture of *A. friderici-et-pauli* and *A. streptophyllus*.

KEY TO ACROSORUS IN THAILAND

- Lamina 80-480 x (4-)6-9mm, texture thickly coriaceous, sori deeply sunken in
lamina **A. friderici-et-pauli**
- Lamina 40-200 x 3-6mm, texture thinly coriaceous, sori protected by folded lamina
A. streptophyllus

DISCUSSION

Holttum (1968) describes and illustrates both *Acrosorus streptophyllus* and *A. friderici-et-pauli* (as *A. triangularis*).

Tagawa & Iwatsuki (1989) report the ecology of *A. friderici-et-pauli* as 'on mossy tree trunks in dense evergreen forests on ridges at medium or high altitudes'. Evidently both species occur in similar habitats in Thailand, as in Peninsular Malaysia (Gunung Beremban), Sabah (Mt Kinabalu) and Sarawak (Gunung Mulu), where I have collected both growing as low epiphytes in low or open ridge crest lower montane and mid-montane forest between 1500 and 1900 m alt. *Acrosorus streptophyllus* should be searched for in Peninsular Thailand in the localities where *A. friderici-et-pauli* has been found.

Gunung Ina (Inas) was formerly included in the state of Perak in northern Peninsular Malaysia, but is now part of southern Peninsular Thailand. It is possible that old collections from areas formerly included in northern Perak, like these of Yapp, are now wrongly filed under Malaysia in some herbaria and that further new records for the flora of Thailand remain to be discovered.

REFERENCES

- HOLTUM, R.E. 1968. *Revised Flora of Malaya* Vol. 2 Ferns. 2nd ed. Government Printing Office, Singapore.
- TAGAWA, M. & IWATSUKI, K. 1989. *Flora of Thailand* Vol. 3 Part 4. Chutima Press, Bangkok.

BOOK REVIEWS

DISTRIBUTION, ECOLOGY AND CONSERVATION STATUS OF CLUBMOSES (*DIPHASIASTRUM* SPECIES) IN LOWER SAXONY AND BREMEN (in German). Karsten Horn. 1997. Naturschutz und Landschaftspflege in Niedersachsen, Heft 38, 83 pages. Erlangen. Available from the Niedersächsisches Landesamt für Oekologie, Abt.2, An der Scharlake 39, D-31135 Hildesheim.

This book is a beautifully illustrated and well researched study on the distribution, ecology and conservation status of *Diphasiastrum* taxa in the north western parts of Germany. It is, as stated on the inside cover, a slightly altered version of the Master's thesis by Karsten Horn submitted in 1997 and supervised by Professors H.W. Bennert (Bochum) and W. Nezadal (Erlangen).

The book has six major parts: morphology and systematics of clubmosses, introduction to the area, material and methods, results, discussion and recommendation for the conservation of clubmosses. It starts off with comprehensive introductions to the geography, climate, geology, soil types and natural vegetation of the area, as well as a collation of many interesting facts about the ecology and biology of *Diphasiastrum*.

Large parts of Lower Saxony are relatively flat with sandy soils prevailing (good for *D. tristachyum* and *D. zeilleri*), but it also includes mountainous areas rising up to over 1,000 metres, in the Harz mountains. The latter have the greatest diversity, with all five taxa (*D. alpinum*, *D. issleri*, *D. complanatum*, *D. tristachyum*, *D. zeilleri*) still present. The geographical variation of the overall area makes for a rich clubmoss flora. The current and historic distribution of all taxa is meticulously documented and is based on several years of field work and herbarium studies. These detailed studies allow the author to investigate the decline in number and abundance of clubmosses in Lower Saxony and to determine some of the causes of this decline. The colonisation of new sites by clubmosses normally follows disturbance. As poor competitors they are forced out when other vegetation becomes established in the area. Change of land use, e.g. heathland, which no longer include regular disturbance, have contributed to the decline. Therefore, many well stocked clubmoss assemblies are nowadays confined to ski slopes or military areas. In addition, collecting for commercial purposes or herbaria, as well as liming of forests, may have contributed to the loss of populations.

From this overview it becomes clear that *Diphasiastrum* has been, and still is, benefitting from or even depending on, human interference. This in turn must raise the question of where *Diphasiastrum* may have had natural sites in the area investigated, and whether protection measures are actually desirable for an organism following Man's activities? It is stated by the author that four taxa of *Diphasiastrum* are at the edge of their distribution in Lower Saxony, but to conclude from this there is a need for special protection is not the only possible inference

especially since their survival depends on wintersports activities. While the causes for decline are well documented by Horn, a forward-looking conservation strategy remains only rudimentary.

The section about the biosystematics of *Diphasiastrum* was a disappointment for me. Horn enthusiastically states “*that the biosystematics of Diphasiastrum in Europe has finally been resolved*” with the publication of a recent study, referring to Stoor *et al.* (1996), which he co-authored. However, the “*evidence*” on which this claim is based cannot be accepted. Horn (1997) and Stoor *et al.* (1996) present the reader with a triangle of three ancestral taxa and their three “*hybrids*”. Their scheme is based on biochemical evidence derived from allozyme electrophoresis of only two enzyme systems. The evidence for the hybrid origin of some taxa is based on “*additive*” allozyme banding patterns. While the use of “*additive*”, and fixed, banding patterns has been applied for determining the diploid ancestry of allopolyploid taxa (Werth, 1989), its application in biosystematic studies cannot be extended to homoploid taxa. If a *Diphasiastrum* plant is the result of outbreeding and cross-fertilisation, either within or between taxa, the F₁ *Diphasiastrum* plant will show additive banding patterns if the parental plants have different allelic forms in the locus investigated. However, taken the homoploid status and the fertility of putative hybrid *Diphasiastrum* into consideration, allozyme patterns will segregate in the F₂ in Mendelian ratios. Therefore additive bands will not be fixed in hybrids between taxa and the use of allozymes as a biosystematic marker in *Diphasiastrum* might be limited. Furthermore, it is stated that “*esterase is the most useful enzyme for unequivocally determining the identity of Diphasiastrum species*” (Horn - in Stoor *et al.*, 1996, p.152; emphasis added). Esterases are plentiful in plants with two to ten loci, and rarely is a genetic basis available to aid interpretation (Weeden & Wendel, 1989). Therefore, it is not, or very rarely, used in systematic studies. The esterase picture published by Stoor *et al.* (1996) shows two gels pasted together and therefore do not represent the desirable side-by-side within-gel comparison. Furthermore, no genetic interpretation for the picture is given. It is well known that esterases can be tissue specific, that their activity may be environmentally induced, and that the absence of breeding and hence segregation data “*can lead to grossly misleading conclusions*” (Oxford, 1973). Taking the arguments above, I fear that we are a long way off a satisfactory answer to the puzzling biosystematics of *Diphasiastrum*. Molecular methods can certainly play a part in solving the riddle but caution should prevail in the light of insufficient data sets and data analysis.

Despite the criticism on a small, but important, part of the book, I congratulate the author on his work about the ecology and distribution of *Diphasiastrum* in northern Germany. There is much need for such comprehensive studies on European pteridophytes. If you can, try to get a copy. The detail and effort presented in this book shows that Karsten Horn loves “*his organisms*”, but such love should not impair his vision.

J.C. Vogel

REFERENCES:

- OXFORD, G.S. (1973) The genetics of *Cepaea* esterases. 1. *Cepaea nemoralis*. *Heredity* **30**:127-139.
- STOOR, A.M., BOUDRIE, M., JEROME, C., HORN, K. & BENNERT, H.W. 1996. *Diphasiastrum oellgardii* (Lycopodiaceae, Pteridophyta), a new lycopod species from central Europe and France. *Feddes Repert.* **107**: 149-157.
- WEEDEN, N.F. & WENDEL, J.F. 1989. Genetics of plant isozymes. In: Soltis, D.E. & Soltis, P.S. (eds). *Isozymes in Plant Biology*, pp. 46-72. Dioscorides Press, Portland.
- WERTH, C.R. (1989). The use of isozyme data for inferring ancestry of polyploid pteridophytes. *Biochem. Syst. Ecol.* **17**: 117-130.

INDEX FILICUM SUPPLEMENTUM SEXTUM PRO ANNIS 1976-1990.
 R. J. Johns. 1996. x + 414 pp. Royal Botanic Gardens, Kew. Price £30. ISBN 1 900347 11 3. Softback.

Index Filicum and Supplements 1-3 were prepared by Carl Christensen and incorporated his opinions on the taxonomic status and generic and specific synonymy of ferns. Each contained additional material at the end of the volume in sections termed *Addenda* and/or *Corrigenda* which were inconvenient to use and sometimes ignored by consulting pteridologists unaware of their existence. Supplement 4 presented the names as published, without taxonomic judgment, as did Supplement 5, which included fern allies for the first time. Supplements 4 and 5 dealt explicitly only with validly published names, included the details of publication of infraspecific basionyms and, to the delight of users, did not include *Addenda/Corrigenda* sections. Supplement 6, like its two predecessors presents the names as published, without taxonomic judgment and, like Supplement 5, includes names of fern allies. Entries for Supplement 6 were compiled by the *Index Kewensis* staff, with associated nomenclatural problems from 1976 to 1980 solved by Frances Jarrett and those from 1981 to 1989 dealt with by Barbara Parris. A useful innovation in the latest supplement is the inclusion of new infra-specific taxa for the first time. Some infra-specific taxa published before 1976 are also included in the main part, e.g. *Polystichum munitum* subsp. *imbricans*, while many more are included in the *Addenda* etc. A useful additional inclusion would have been the card index held at Kew of infra-specific pteridophyte taxa compiled for the later part of the years covered by Supplement 5. Infra-specific basionyms have been included without their place of publication, however, contrary to the policy of Supplements 4 and 5, e.g. *Aspidium munitum* var. *imbricans*, *Dryopteris sciaphila* vars *rapaensis* and *raivavensis*, *Lycopodium miyoshianum* var. *coreanum* and *Polystichum lobatum* var. *ruwenzoriense*.

Unfortunately Supplement 6 differs in some other ways from the two preceding supplements and appears rather muddled in concept and confused in execution, particularly the *Addenda* etc. *Addenda* etc. were a feature of *Index Filicum* and Supplements 1-3, but were dropped from Supplements 4 and 5. In these last two supplements names dating from before the starting dates (1934 and 1961 respectively) which were not included in the original *Index Filicum* nor in preceding supplements were included in the body of the work, but preceded by an asterisk to distinguish them from names published in the years covered by the supplements. Thus they are clearly visible to the reader without the need to consult a separate section. It is disappointing to find an *Addenda* etc. tacked on to the end of Supplement 6 behind the *Catalogus literaturae* almost as an afterthought. I do not understand why validly published names are included here rather than in the body of the text. Unfortunately the new names in the *Addenda* have no distribution, unlike those elsewhere in the volume. Additional data and omissions from Supplement 5 are not all in the *Addenda* by any means. A sample of pre-1976 names in the main part of the Supplement (without asterisk) includes *Aspidium lobatum* (later homonym), *Ctenopteris khasyana* (earlier combination), and *Alsophila* and *Sphaeropteris* spp. (omitted from Supplement 5). *Carpogymnia dryopteris*, *Huperzia perrieriana* and *Lunathyrium lasiostipes* are included in Supplement 5 and repeated in *Addenda* to Supplement 6 with the same reference. *Goniophlebium manniense* and *Loxogramme tibetica* are in both the main body of text to Supplement 6 and in the *Addenda*.

The inclusion of invalidly published names, both in the body of the text and in the *Addenda* etc., differs from previous supplements and is a source of confusion. If this is a standardisation of *Index Filicum* to the *Index Kewensis* format and will be a feature of future supplements a note to this effect would have been useful. The Introduction notes that Ching published some of his species several times in different publications and these have been listed so that the monographer has access to all these published names (even if the species had already been validly published). As one of that rare breed, a fern monographer, who has consulted *Index*

Filicum for more than thirty years, I am not interested in anything other than validly published names and am not convinced that multiple citation adds anything other than padding.

There are some careless errors in Supplement 6. Some names have been placed in the wrong genera e.g. *Selenodesmium bellisquamata*, *S. plebiscopa*, *S. werneri* should be under *Selliguea*. *Thelypteris remotipinna* is correctly spelt in the main body of text, but appears in *Addenda* etc. with the same authors and place of publication as *T. remotifinna*, likewise *Mecodium coreanum*, included in Supplement 5, is misspelt as *Mecodium doreanum* in *Addenda* etc. the details of author, place and date of publication are identical. Compounded epithets with hyphen, contrary to the *International Code of Botanical Nomenclature* Article 60.9, have been included e.g. *Crypsinopsis albido-paleata* and *Hypodematium squamuloso-pilosum*. One might have expected a publication from Kew to have authors' names consistent with the excellent *Authors of Plant Names* by Brummitt and Powell, but Hermann Christ is consistently cited as 'Christ' rather than H.Christ as recommended by Brummitt and Powell and Lev. has been used instead of H.Lév. There are also inconsistencies in the citation of place of publication. Proctor's *Ferns of Puerto Rico and the Virgin Islands* is cited just as *Mem. New York Bot. Gard.* 53 (1989) with the journal reference included in the *Catalogus literatureae*, but Mickel and Beitel's *Pteridophyte flora of Oaxaca, Mexico* is cited as '*Pterid. Fl. Oaxaca (Mem. New York Bot. Gard.* 46 (1988))' and the journal title is not mentioned in the *Catalogus literaturae*, while Brownlie's *Pteridophyte flora of Fiji* is cited as '*Nova Hedwigia Beih.* 55 (*Pterid. Fl. Fiji*) (1977)'. Hybrids are indicated by x in front of their specific epithet, but not for *Leptopteris* x *intermedia* (André) Brownsey. The paper where this combination is made is missing from the *Catalogus literaturae*; it is: Brownsey, P. J. (1981). A biosystematic study of a wild population of *Leptopteris* hybrids in New Zealand. *New Zealand J. Bot.* 18: 343-352. The mistakes listed above were found during an hour's browse and doubtless many others await discovery.

Although it is not obvious at first sight, Supplement 6 differs from its predecessors in a very important point, which has changed the way in which I use *Index Filicum*. The original and previous five supplements included references to names when they were first combined, so looking up a particular combination was quite straight-forward one started with the most recent supplement and worked back until finding it (or not). Supplement 6 includes the same combinations but made by different authors or in different references, and thus introduces an unexpected level of confusion. Some names are included both in Supplement 5 and Supplement 6 with different authors and/or references, e.g. *Grammitis cavisora*, *Plesioneuron fulgens*, *Pronephrium lakhimpurensense*, *P. nudatum*, *P. penangianum*, *P. triphyllum*, *Pseudocyclosorus ochthodes*; those in Supplement 6 are superfluous and should not have been included. Again, there is no explanation for the change of policy in Supplement 6. Perhaps the editor was unaware of the careful checking carried out by editors of earlier supplements of *Index Filicum* to ensure that combinations were not duplicated unnecessarily. Do not expect to browse back through the *Index Filicum* supplements to find the name you are seeking. Now you will have to begin at the original, with its *Addenda* and *Corrigenda* (before the *Catalogus literaturae*), and progress to Supplement 1 and *Corrigenda* (after the *Catalogus literaturae*), Supplement 2 and *Corrigenda* (after the *Catalogus literaturae*), Supplement 3 and *Addenda et Corrigenda* (before the *Catalogus literaturae*), Supplements 4 and 5 (mercifully without *Addenda* and/or *Corrigenda*) and Supplement 6 with *Addenda* etc. There are numerous names cited twice in Supplement 6, e.g. *Ctenitis tonduzii*, *Deparia polyrhizon*, *Grammitis poeppigiana*, *G. rigescens*, *Huperzia kamaensis*, *H. nylamensis*, *Palhinhaea cernua* var. *sikkimensis*, *Xiphopteris bryophylla*. Only the earliest citation should be included as all others are nomenclaturally superfluous. At least in *Emendata* the later combinations are marked 'non'!

All taxonomic pteridologists will need *Index Filicum* Supplement 6, which contains much useful information, but I am sorry to see that the high standards of earlier supplements have not been maintained and look forward to the day when the *Index Filicum* data is available on CD-ROM and more easily accessible than at present.

INSTRUCTIONS FOR AUTHORS

Manuscripts on all subjects of pteridology are welcome and should be sent to the editor:

Miss J.M. Camus, Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, UK [fax +44 - (0)171- 9260, e-mail j.camus@nhm.ac.uk].

PLEASE NOTE that papers should not usually exceed 20 printed pages and are generally expected to be considerably shorter. Subject review articles will be considered. Short notes are acceptable e.g. new records. The senior author should supply fax and e-mail numbers if possible to facilitate correspondence.

MANUSCRIPTS should be written in English (British), double spaced, preferably on A4 paper. Three hard copies are required in the first instance; a version on disc will be required after revision (WORD in WINDOWS 95, DOS preferred). All manuscripts will be refereed. The title should reflect the content of the paper and be in **BOLD CAPITALS** and centrally aligned. Generic and specific names should be in italics and any title containing a generic or specific name must be followed by the family and Pteridophyta in brackets e.g.

***TRICHOMANES SPECIOSUM* WILLD. (HYMENOPHYLLACEAE:
PTERIDOPHYTA) IN SOUTHERN SPAIN**

Author abbreviations should follow Pichi Sermolli's (1996) *Authors of scientific names in Pteridophyta*, Royal Botanic Gardens, Kew.

MAIN HEADINGS: in **BOLD CAPITALS** and centrally aligned.

SUBSIDIARY HEADINGS: in *italics* and left aligned.

AUTHORS' NAMES AND FULL ADDRESSES: following the title and centrally aligned.

KEY WORDS: up to five.

ABSTRACT: should reflect the content of the paper.

FIGURES: there is no distinction between photographs, line drawings and maps in numbering and all should be presented in a form ready for reproduction. They should be of the required magnification or larger with a scale bar where appropriate. Lettering or numbers (Arabic) should be sufficiently large to be legible if reduction is necessary during printing. The number of photographs allowed in any one issue is limited by cost. Figure captions should be on a separate sheet.

TABLES: can be printed in either portrait or landscape format. Authors should consider this when they are preparing tables. If possible tables should be presented in a form that can be reproduced (like a figure).

MEASUREMENTS: should follow the metric system.

REFERENCES: should follow the style of this issue of *The Fern Gazette*, e.g.:-

HOOKE, W.J. 1864. *Species Filicum*, 5. Dulau & Co., London.

PICHI SERMOLLI, R.E.G. 1977. Fragmenta pteridologiae VI (*Crypsinopsis*). *Webbia* **31**: 240-242.

STEVENSON, D.W. & LOCONTE, H. 1996. Ordinal and familial relationships of pteridophyte genera. In: CAMUS, J.M., GIBBY, M. & JOHNS, R.J. (eds) *Pteridology in perspective*, pp. 435-467. Royal Botanic Gardens, Kew.

Journal abbreviations should follow *Botanico Periodicum Huntianum & Supplements*.

Alterations from the original text at proof stage will be charged for unless they are minor points of detail. Twenty-five offprints will be supplied free to the senior author. Additional copies may be ordered at the page proof stage.

Books for review
in the British Pteridological Society's journals
should be sent to:
Miss J. M. Camus,
Department of Botany
The Natural History Museum
Cromwell Road
London SW7 5BD



The British Pteridological Society

THE FERN GAZETTE

VOLUME 15 PART 6

1998

CONTENTS

MAIN ARTICLES	Page
<i>Trichomanes speciosum</i> Willd. (Hymenophyllaceae: Pteridophyta) in southern Spain <i>F.J. Rumsey & J.C. Vogel</i>	197
Population analysis of the type localities of some recently recognised taxa of British <i>Pteridium</i> (Dennstaedtiaceae: Pteridophyta) <i>K.M. Bridges, C.J. Ashcroft & E. Sheffield</i>	205
The addition of <i>Acrosorus streptophyllus</i> (Baker) Copel to the flora of Thailand <i>B.S. Parris</i>	215
BOOK REVIEWS	204, 214, 216, 218
INSTRUCTIONS FOR AUTHORS	220

THE FERN GAZETTE Volume 15 Part 5 was published on 15th December, 1997

Published by THE BRITISH PTERIDOLOGICAL SOCIETY, c/o Department of Botany,
The Natural History Museum, London SW7 5BD

ISSN 0308-0838

Printed by Metloc Printers Ltd, Caxton House, Old Station Road, Loughton, Essex IG10 4PE